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DISCOVERY

Determinants of farming system and food crop production among small holder farmers in Rungwe District, southern highlands of Tanzania

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ABSTRACT

Variations in the agricultural crop production results from differences in types of farming systems, social economic situation and implication of climate variability across agro-ecological zones. Land fragmentation, lack of information to inform the best adaptation measures and realisation of opportunities characterise the farming systems in the study area. The farming systems differ among the farms depending on the available resources and constraints, location and physical condition, government policy, socio-economic, political pressures and the philosophy of the farmer. The study employed survey method that includes household questionnaire, Focus Group Discussion (FGD), Key Informant Interview (KI), and Field Observation. The collected data were analysed through content analysis for qualitative and SPSS and Excel software for the quantitative data. The study indicates that farming systems practiced by smallholder farmers are characterized by land fragmentation, lack of capital, use of poor technologies, unreliable market and inadequate information to inform farmers the best adaptation measures and opportunities for increasing agricultural crop production. Thus, the increased risk and vulnerability to crop production and livelihood, especially, within small land sizes that hinders crop diversification and mechanization to improve productivity. To a large extent of agricultural crop production in small

units focused on home consumption and food security being the main concern. The study recommends the need for strengthening the capacity of smallholder farmers and institutions for identifying, assessing and addressing the challenges within different farming system through educating farmers and other relevant stakeholders on improving livelihoods, productivity and agricultural crop production.

Key word: farming system, crop production, smallholder farmers and determinant

1. INTRODUCTION

The farming systems differ among the farms depending on the available resources and constraints, geographical location and climatic condition, government policy, socio-economic, political pressures and the philosophy of the farmer. It can be seen in different perspectives depending on the characteristics and criteria used (Kristensen and Hermansen, 2010; FAO, 2013). Kalisa, (2007) and FAO, (2013) ascertain that the type of farming systems can vary from a simple system where only one or two activities are undertaken, to the more multifaceted systems where several enterprises are concurrently undertaken on the farm. According to FAO (2000) and Dixon, et al., (2001) individual farm has its own specific characteristics, which arise from variations in resource endowments and family conditions. The farming systems generally relate the whole farm rather than individual elements of the farm, and are attentively associated with livelihoods, as agriculture remains the most important component of rural people's living.

Depending on the scale of the analysis, a farming system can encompass a few dozen or many households, which can be described as the result of a complex interplay among a number of interdependent components and qualities of four factors of production (Dixon et al., 2001). Such factors include land, labour, capital and management processes, which comprise crop, livestock and off farm enterprises within the knowledge possess to maximize the attainment of the goal (Dixon et al., 2001; FAO, 2013; Bareja, 2014). It compound a multifaceted combination of inputs, which are managed by farming households, and influenced by ecological, political, institutional and socio-economic factors (Liwenga et al., 2009; FAO, 2013; Bareja, 2014).

Farming systems defined as a unique and reasonably stable arrangement of farming enterprises, which household manages basing on the well-defined practices to respond to the Bio-physical, and socio-economic environments (Shaner *et al.,* 1981 cited in Kalisa, 2007). FAO (2003) defines a farming system as a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. It is also defined as a multifaceted related, matrix of soil, plants, animals, implements, labour power, capital and other inputs controlled in parts by farming families and to some extent influenced by political, economic, institutional and social forces, which operate at various levels (Dixon *et al.,* 2001). At a local level a farming system simple denotes a combination of all production activities on a particular farm, which can be diversified by the number and types of activities.

A number of different factors can cause agricultural production and productivity to increase or decrease. Such factors include socioeconomic factors, technical factors and environmental conditions. The controls exerted by environmental factors, specifically, climate and weather appear crucial in agricultural crop production (Spencer et al., 2015; Mbilinyi et al., 2016). Though, agricultural production and productivity is dealt within the context of a set of factors that include the socio-economic, technical and environmental to realize a significant agricultural production, productivity and developments.The natural resource base influences the decision of farming systems as some of these resources are out of farmers' control.

Changes on the key factors influencing agricultural crop production dynamics include issues related to dynamics of capital, land and labour allocation, allocation between commercial and self-subsistence farms have an impact on the livelihood of farming community and sustainability of agricultural food production (URT, 2008; Sokoni, 2013; URT, 2015). The total production output and per-capita income of the population employed in the agricultural sector and impact and efficiency of public support policies for agriculture denoted to be fluctuating since 1961 (URT, 2007a; URT, 2010; OECD, 2013). Based on the definitions a number of key factors can be used in classification of farming systems that include (i) the available natural resource base; (ii) the dominant pattern of farm activities and household livelihoods, and (iii) the intensity of production activities. In this study the main classification of farming system is based on the dominant pattern of farm activities and household livelihood characteristic.

2. METHODOLOGY

Study area

The study was conducted in Rungwe district, Mbeya region in the southern highlands of Tanzania. The district is among the main food basket for a long time in the country. It characterized by three agro-ecological zones based on altitude, temperature, precipitation pattern, steady growing seasons, normal soil water holding capacity and physiography features. The zones include

lowland, midland, and highland zones, that characterised by dominant farm activities, type of crop grown, farming methods and household livelihoods. Across these zones, farmers have developed different farming systems to produce agricultural outputs and other income generating activities to sustain their livelihood.

The district is rich in a type and variety of crops. Most of the crops produced in other parts of Tanzania are grown in the district (Gwambene, 2012, Tilumanywa, 2013). Maize is the most important food crop and is produced in all zones in the area (URT, 2010). The staple food are rice in lowland, banana in midland and maize in the highlands and for most people these crops served as both a food and cash crops. Other main crops produced in the district include beans, coffee, tea, peas, finger millet, sorghum, and groundnuts. Cocoa, cassava, round and sweet potatoes, wheat, paddy, pyrethrum, and a wide variety of horticultural crops and fruits are also grown in the area (Nyuza and Mwakaje, 2012; Tilumanywa, 2013; Williamson et al., 2013). The allocation of crops in different plots is determined by the relative importance of the crop in each farming system.

Data collection method

Both quantitative and qualitative methods were used to collect primary data from the study areas that include key informant interviews, focus group discussion, household surveys and field observation. For effectiveness and triangulation of data collection, these methods were used in such a way that they complemented each other. Quantitative data were collected through a household survey using a structured questionnaire that was divided into themes with specific information to be collected. The Focus Group Discussions (FGD), key informant interviews and field observation provides a basis for discussion through which qualitative and quantitative information was collected.

Face-to-face interviews with key respondents were guided by a semi-structured questionnaire that was administered in different strata or key/ targeted groups, including local government at the district level, village government, village/ward extension workers and elderly people (males and females) who understand the area. A checklist of guiding questions was prepared for use in the FGD. The FGDs were arranged in such a way that all groups were involved, based on gender, age, occupation and socio-economic situation. At household level, a structured questionnaire was used to gather information through interview with the heads of households. The questionnaire used to collect information on the characteristics of households', socio-economic, awareness and perception of farming system and crop production. Field observations were undertaken for gathering biophysical information and confirming information gathered from interviews, focus group discussions and household survey.

Secondary data was collected through extensive review of literature from previous studies/ relevant researches on farming system and crop production. The review focused on determinant of farming system, crop production, community livelihood activities and socio-economic activities. This information was gathered from different sources, including library, environmental departments, agricultural and livestock departments and natural resources divisions. Furthermore, variables such as socio-economic, land tenure, resources management, agricultural production, food security and incomes in selected areas were collected.

Data processing and analysis

The data collected from different sources and methods were edited, coded, tabulated, compiled, processed and analysed using different techniques. Quantitative data from household survey was compiled and analysed by using Statistical Package for Social Sciences (SPSS 20) software while qualitative data was analysed during and after data collection using content analysis (Ashley and Boyd, 2006). Qualitative data from key informant interviews, focus group discussions and observations were examined using trend and content analysis and presented in a summary form using cross tabulations (Ashley and Boyd, 2006; ACAPS, 2015). Cross tabulation allows a comparison of different study parameters among villages and across agro-ecological zones. The results displayed in the form of Tables, Bar charts and Figures. Qualitative information is presented in descriptive form.

3. RESULTS AND DISCUSSION

Characteristics of the farming system

This study revealed that most of the farming systems are managed by smallholder farmers except for cash crops such as tea, which is owned by estates or in large scale farming areas. Food crop production in all zones was dominated by smallholder farmers. The three zones characterised main farming systems in the district, though the existing livelihood and potential future development that depends upon the technological, quality and availability of natural resources.

Characteristics and classification of farming systems take into consideration the quality, average farm size, available natural resources and agricultural production methods. Based on these criteria, farming systems in each zone was distinguished. The names chosen for individual farming systems reflect the key distinguishing attributes, notably dominant livelihood sources such as types of crops and crop-livestock integration. The study results revealed that farming systems are commonly not exclusive, at the individual

household level; any particular household often practices a mixed set of strategies. In all zones, farmers intensify existing production patterns, diversify agricultural activities, and involve in off-farm income generating activities, both agricultural and non-agricultural activities. Individual households are involved in more than one farming system.

Farming systems characteristics in lowland zone

The weather in lowland is generally warm with moderate rainfall suitable for cultivation of paddy, maize, beans, cocoa, bananas, groundnuts, simsim and fruits such as avocados, oranges and mangoes (URT, 2010). The main farming systems in the area include paddy, maize mixed system, cocoa mixed farming and paddy mixed farming. Such farming practice is commonly used in the lowland area as a way of diversification, especially, in bananas, maize and beans. Rice is a pure standing crop which is grown under excessive moisture. Based on field observation, FGD, Key informant and household survey, the farming systems in this area is negatively affected by climate variability (mainly drought, floods, unpredictable rainfall and an increase of temperature), water shortage for irrigation, pest and diseases, land exhaustion and high price of inputs. The following farming system where identified in the lowland:

Irrigated paddy-farming systems: This embraces a broad range of production for both food and cash crops. It is dominated by improved irrigation schemes with slightly practices within traditional irrigation.

Paddy farming system: This is the wetland based farming system, dependent on seasonal rains but occasionally supplemented by irrigation.

Maize mixed crop farming systems: This system is characterized by specific dominant crops or mixed crop-livestock systems; and is practiced by many smallholder farmers, where different types of crops are grown in small pieces of land. For example, crops such as maize, beans, Bambara nuts, groundnuts, cassava and sweet potatoes are produced. In this farming system intercropping of maize with beans is common in both zones. However, maize mono cropping (pure stand) was preferred by 83% of farmers in all zones together with relay farming practices in the highland zone.

Fruits and tree-farming system: This system is commonly used at the homesteads where fruit trees such as oranges, guava, avocado and mangos are grown. Few people are also involved in gardening activities.

Cocoa mixed farming system: This is a common system in the lowland where cocoa trees are intercropped with other crops, especially bananas and other tree crops such as oranges, guava, avocado and mangos.

Farming systems characteristics in midland zone

In the midland zone the climate, soil type and terrain that supports a wide range of crops. In this area farms are characterized by small sizes that are used to produce crops throughout the year depending on the types of crops. Based on FGD and key informant interviews the major farming constraints in the area include land exhaustion, the high price of inputs, rainfall fluctuation, pest and diseases, unreliable market especially for bananas. The following farming system where identified in the midlands:

Mixed banana farming systems: These are rain-fed farming systems practiced in the Midland, lowland areas and gentle slopes in the highland areas. In this system a mixed crop-livestock systems is common. Many farmers in the midland zone predominantly practice the mixed banana farming system.

Coffee – banana farming: Basing on key informant interview and FGD this was among the main system used before 2000. Due to the decline in coffee market the system has almost collapsed, and currently practiced by only few farmers. In this system bananas are intercropped with coffee, where banana provides shade and serve as a food crop produced in the area.

Fruits and tree farming system: This farming system involves planting of fruits at the homestead and but practiced by a few farmers due to land shortage.

Tea - trees farming system: This is a pure stand crop grown in midland zone, sometimes intercropped with trees for shade.

Gardening mixed farming system: this type of farming system depends on seasonal rainfall, but occasionally supplemented by irrigation, especially during the dry season. Due to increasing climate variability, the number of farmers involved in this farming system has increased.

Maize mixed farming system: This system often incorporates mixed farming elements and practiced by many smallholder farmers, where a number of crops are intercropped. It is common to grow maize with other crops in the same land under this farming system.

Through discussion with key informants, coffee-banana farming systems were the common systems before 2000 in the area. However, coffee production is reported to have declined in 2000's partly due to the decline of the coffee market and high production cost. Through FGD, Key informant and household surveys, the high coffee production cost was associated with an increase of pest and diseases and reduction in input subsidies. Another reported cause of declining yield was related to inadequate supply of seasonal agricultural inputs. The vital problem lies in the eroded profitability in coffee production that precipitated by

declining yields due to increased production cost. The quality of coffee produced also has deteriorated up to less than 1% of the proportion of coffee in the top five classes which, is a big drop from about 16% attained 20 years ago (Kristensen and Hermansen, 2010). Such factors resulted in many farmers abandoning coffee farming, and reverting to production of other crop such as banana, tea, maize and horticultural crops with more promising market and better price.

Farming systems characteristics in highland zone

The farming systems in the highland zone are characterized by few crop varieties as compared to the middle and lowlands. Based on key informants, household survey and FGDs the main crops grown in this zone is mainly maize, round potatoes and few growing beans, pumpkins, cabbages and garden peas. It was further reported during FGDs that farmers plant trees as an alternative to the pyrethrum, which used to be a cash crop in the area. The main constraints to farming in this zone include heavy rainfall, fogs, frost and crop pests and diseases. Soil exhaustion also affects agricultural crop production in the area and has necessitated the use of inorganic fertilizers, especially in round potato production. The widespread use of fertilizers in this zone was linked with commercialization and increased agricultural production. The use of chemical fertilizers reported to increase harvest yield of round potato up to 120 and 150 bags (1bag = 100kgs) per hectare depending on the extent of fertilizers and pesticide usage, the type of fertilizer applied and the location of the field (Tilumanywa, 2013). The identified farming system in the highland includes:

Maize farming system: This system was identified as a main farming system across agro-ecological zones with different production patterns. In this zone maize is produced for both food and cash, and most of the farmers are engaged in growing this crop.

Maize–round potato farming system: This system commonly practiced by most farmers and in most cases it is practiced under relay farming. Maize is planted in rows between the lines of round potatoes when about to harvest. Other farmers intercrop round potatoes with maize to increase production and crop diversity.

Round potato farming system: This is one of the booming farming system in the highland zone that attracts more farmers due to increased demand of the crop in cities and urban areas. However the system was reported to have high production cost, which requires high initial capital.

Maize, fruits and tree farming: Tree planting is becoming common in the highland zone especially for those who own land. In this system farmers plant trees in their maize fields, especially the pines as an alternative to agricultural crop production that is declining due to land exhaustion and increasing climate variability. The trees were reported to be harvested after seven years and in the first one to three years, farmers can mix trees with other crops, mainly maize and garden peas.

Maize–legume/ vegetable mixed farming system: This system is practiced by a few farmers, and entails vegetable production, mainly cabbages and carrots. However, the production of vegetables was reported during the FGDs to be low, mainly caused by extreme cold weather and frost limit productivity. Most farmers mix maize with pumpkins and beans or garden peas. This farming system used as an important strategy for crop diversification in the highland zone

Poor soil management practices are among the characteristics in the highland zone as also described in Gwambene (2012). This is partly a result of decline in soil fertility due to over-cultivation and poor soil management. Most potato producers rent fields and that affect long-term soil management strategies. The rented land accords less management measure as opposite to owned land, especially for a long term measures that reduce soil degradation. Based on the FGD and key informant interviews agricultural production in this zone is declining as compared to midland area. The round potato production is becoming more expensive due to increase in production cost resulting from climate variability (especially fogs and frost) and land exhaustion.

Crop production, contributing factor

Agro-ecological zones and crop production

Agro-ecological zones and type of crop analysis indicated a significant interplay between cropping seasons and agro-ecological zones. Land allocation for particular crop varieties was linked to agro-ecological zones. The type of crops to be produced in all zones were determined and adjusted according to their characteristics and constraints across the agro-ecological zones. Based on the agro-ecological zones, farmers in the highland zone allocate more land for crop farming as compared to the lowland and midland zones. This was due to the fact that the highlands have a lower population density and few crop varieties/ types due to its physical and edaphic characteristics.

Farm sizes and land allocation by crop

Land scarcity due to exhaustion and increase of population characterises the agricultural production. In all study zones, farmers own small pieces of land. For example, in lowland and midland zones farm areas are small, ranging from 0.25 to 3 acres as indicated in Figure 1.

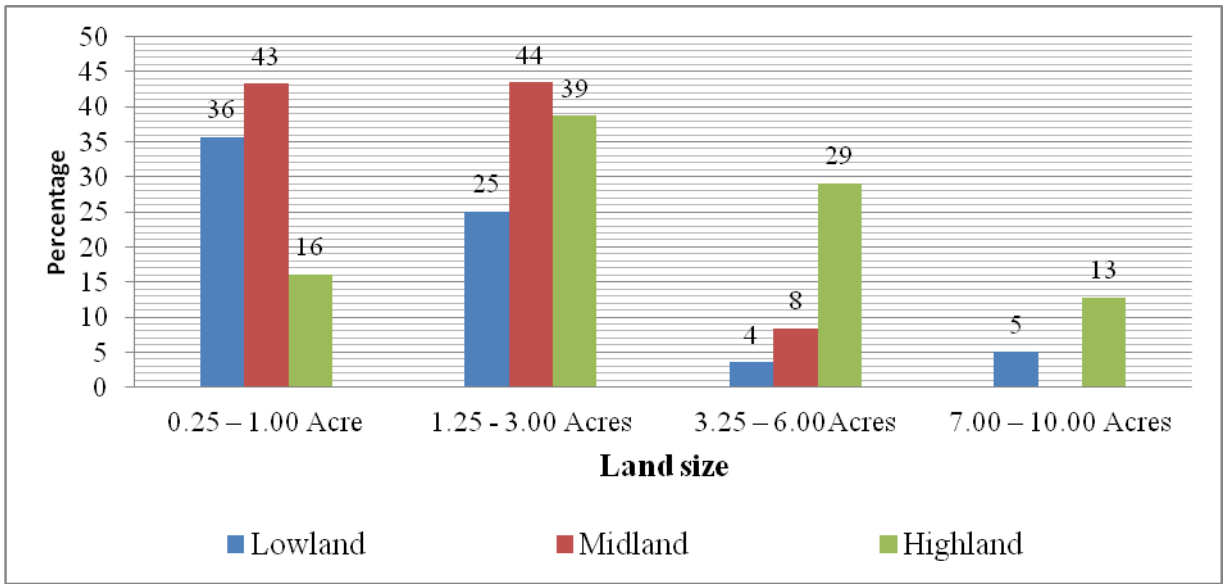

Figure 1 Total land owned within the village

The largest average areas owned are in the highland zone with an average of 3.67 acres, followed by lowland with an average of 2.05 acres, while the smallest are in the midland zone with an average of 1.65 acres. This study revealed that most farmers own land or rent, land outside the village because they have access to land either through inheritance from their relatives or buying land because of fertility and conducive climate for agricultural crop production in the area. A few bought land as an asset (this was especially for those employed in different sectors including business). Key informant interviews in lowland, claimed that some farmers retained ownership of fields in the place of origin as an asset even after shifting to other places. Also, some farmers look for land in other areas as a way to diversify their farming activities. It was further revealed that smallholder farmers used to own many small size fields within and outside the village as the way to reduce the risk of crop failure and also due to land shortage in the area.

Increase of population in the area increased demand for land for agricultural production, as the available land has to be subdivided among the members/heirs of households. This observation is in line with Tilumanywa (2013) who also reports that issues of access to and use of land in Nyakyusa culture are still favoured by the traditional rules of inheritance. Such traditional land access has an influence on land size for different use. In terms of the types of crops in each zone, the highland zone is more devoted to round potatoes and maize production, while the midland bananas receive high priority as compared to other crops. In the lowland zone, most farmers are involved in rice production.

Equipment, inputs use and agronomic practices

FGDs and household survey described the hand hoe as the main tool used for land preparation with only few farmers using oxen plough (about 5%) in the lowland. The reasons provided for not using mechanized tools in the highland zone included the terrain and the type of soil that is very light. The main type of soil in highland zone is volcanic ash soils (Andosols) that are usually light and fluffy and are easily tilled by using simple tools (Tilman et al., 2002; Tizale, 2007; Gwambene, 2012). In the Midlands farmers own small pieces of land for mechanization to be feasible, in addition to the banana and other perennial crops such as tea and coffee. The hand hoes and herbicides are used for weeding. In the lowland due to low financial capacity and soil compactness, farmers are using oxen ploughs for land preparation.

Resource mapping, historical trend line, seasonal calendar and matrix scoring and ranking, undertaken during FGDs revealed that land preparation depend on the onset rain in lowland, while in the midlands and the highland zones farmers use seasonal calendar. The main planting season in the study area is during the months of August to January. Similarly the main harvesting period is from February to July depending on the time of planting and type of crop.

In terms of type of seeds grown, most of the respondents use both local variety and improved seeds. However, some of indigenous varieties have been abandoned mainly due to their susceptibility to diseases, palatability (e.g. *halale* and *haladoni* banana varieties) and the long time they take to mature (e.g. *ndyali, mwakamele and ngego*), which delays income realization. The new banana varieties grown include *Uganda*, *Malindi, Mshale, Matoke, FIA and Bukoba*. It was established that potato varieties that used to be grown in the past, such as *ndelenga* and *kathumuni* are no longer grown. The major reason was lack of market demand for these potato varieties and low harvest. The improved varieties grown include *Arika, Kagiri, Kidingh'a, Tigo*and *CAP*. These improved varieties are believed to have higher commercial value.

During FGDs and key informant interviews, maize mostly, planted in rows at the recommended spacing and weeded at least twice in the midland while in the highland most farmers weed once per season. The main reason for weeding once in the highland zone is to reduce the production cost, specifically labour cost as most of them do cultivate a large size of farm. Fewer farmers in all the three zones use inorganic fertilizer. The main constraint on fertilizer use was the lack of cash for purchasing inputs and high price. Many farmers applied organic manure in lowland and middle land while in the highland zone only a small proportion of farmers used manure. Figure 2 shows the use of fertilizers in maize production with a small proportion in all zones. The small number of users of chemical fertilizers may be attributed to the high price of fertilizers and limited knowledge on the use of fertilizers.

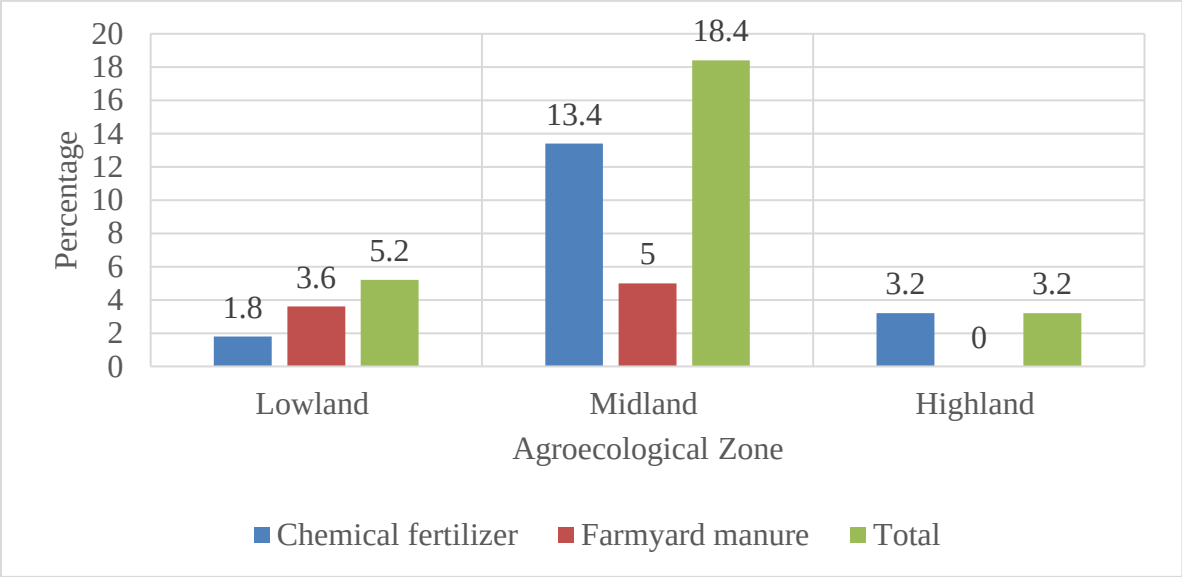

Figure 2 Fertilizer and manure application for maize production across zones

The study results showed the extensive use of fertilizers in the midlands is due to the small size of land areas and farmers are struggling to increase production. In the highland zone most farmers also grow maize in the fields used for round potato production. This is due to the fact that round potato production needs fertilizers that usually remain in the fields after harvest that can also be used by maize plants. Based on the FGD and Key informant interviews in this zone, only few farmers had large farms that could be allowed to increase fertility, as compared to other zones. The use of farmyard manure in the highland zone was limited due to the small number of livestock kept in the area and for those who had livestock, their fields were located far from their homesteads thus making it difficult to transport manure to the farms.

Household characteristics and crop production

The household characteristic was among the main factors for farming systems at a local level in all zones. Results from FGDs and household survey indicated that the characteristics of households have an influence on farming system and management practices. The important household factors that were claimed to be influential at the household level included gender and marital status, education level, and household size. These factors influence farming systems, adaptation strategies, resources management and utilization as revealed during FGD, key informant interview and household survey. The poor households were more subsistence-oriented, whereas better-off households were more cash and profit-oriented. Also, women preferred more food crop for improving food security than men who were more cash crop oriented. Such factors also affected the decisions in agricultural production,

especially, on what, in what way and how much to produce. Different decisions made at households attributed to variation in household characteristics, for instance labour availability, knowledge/skills, access to capital and off-farm income.

Household characteristics influence the production system and the type and quantities of food used. For instance, the production objectives at a household level differed Gender and marital status, household size, age and education level. The perceptions and attitudes of the person can differ by the marital status of the persons. Household characteristics are among the important factors used by farmers to make their decision (Poortinga et al., 2003). Other important factors for decision making in production include the political /economic conditions, and available natural resource base. Such factors influence the farmers' choice and the relationship between farmers' choices and environmental and form the basis for household decision-making.

In broad-spectrum the household characteristics (labour, land availability, consumption needs, food preferences, capital assets, knowledge base-literacy/traditions, religions, off-farm income, and willingness to take risks) influence the household decision-making (Kristjanson et al., 2012). The study revealed that poor households with few capital assets are less willing to take risks. For example, in the highland area about 70% of respondents said they are not willing to grow round potatoes during the mid-season to avoid the risk of crop loss. Farmers with a good crop production knowledge are more easily and more effective in taking part in activities and use of extension services and new technologies. For example, in the highland zone the households with capital assets, knowledge and diversified source of income were involved in round potato production (round potato production needs large amounts of capital).

The choices about what, how, and how much to produce can affect and influence environmental, farming systems and consequently affect the quantities and quality of the products offered on the market. General farmers' income in agricultural production is influenced by a number of factors that including education level, means to access market information, household size, gender, marital status, production costs, land size, farming experience and selling price (Wegner and Zwart, 2011;). For example, the impact of education is higher and expected to improve the quality of labour, in a rapidly changing technological or economic environment (Anley et al., 2007; Burton et al., 2010).

Social and political factor in crop production

Social and political factors affect farming in a number of ways. The type of farming practiced is related to the social structure that has effects on the type of crops that are grown. Social factors can affect agriculture through ownership and inheritance of land. For instance, in the region land of a father is divided between his children leading to the breaking up of already small farms into smaller units which are uneconomic to farm (Tilumanywa, 2013).

Political factors also play a vital role in agricultural development. The government policies regarding land, irrigation, marketing and trade, etc., have a direct impact on agricultural production and development (Hassan and Nhemachena, 2008). Policy awareness and strategies among interviewed farmers were low. In most cases, farmers used by-law, which are sometimes conflicting with other national policies. The study revealed that even where the by-laws were known the political will has a greater impact on its implementation. For instance, in the lowland farmers are encouraged to grow drought tolerant crop such as cassava, but instead, due to lack of enforcement of by-laws farmers grow maize and rice. Maize and rice are preferred as a staple food and also offered a good price as compared to cassava. Similarly, subsidies, agricultural marketing and international trade and tax policy of the government also have a direct impact on agricultural production and its development.

Determinant of farming systems

The determinant of farming system can make a difference in production/ farming if there is or not. Important farming system determinant includes natural physical like climate, soil and topography; and biological factors that include all things that have a biological nature, such as crop, livestock, weeds, pest and diseases. Exogenous and indigenous agricultural production factors were studied in all study zones. Exogenous factors included population, land tenure, off farm opportunities, social infrastructure, credit, marketing, technology, extension services, and input supply system. Endogenous factors are family consumption, health and nutrition status, level of education, food preference, risk aviation, attitude, and gender relation.

A Farming system is determined partly by environmental factors of climate, soil, natural vegetation and topography and partly by socio-economic factors such as the customs of the people and level of technology, population density, financial resources, etc. In assessing the factors for agricultural crop production, farmers were asked to provide the factors prospering to changes in crop and management strategies. Basing on the household surveys the main factors for agricultural production and farming determinant includes climate change (30.9), knowledge (45.6) and Land (23.5). Such factors influenced the choice, type of crops and production methods in all study zones. Figure 3 indicates the reason for changing the type of crops and production strategies.

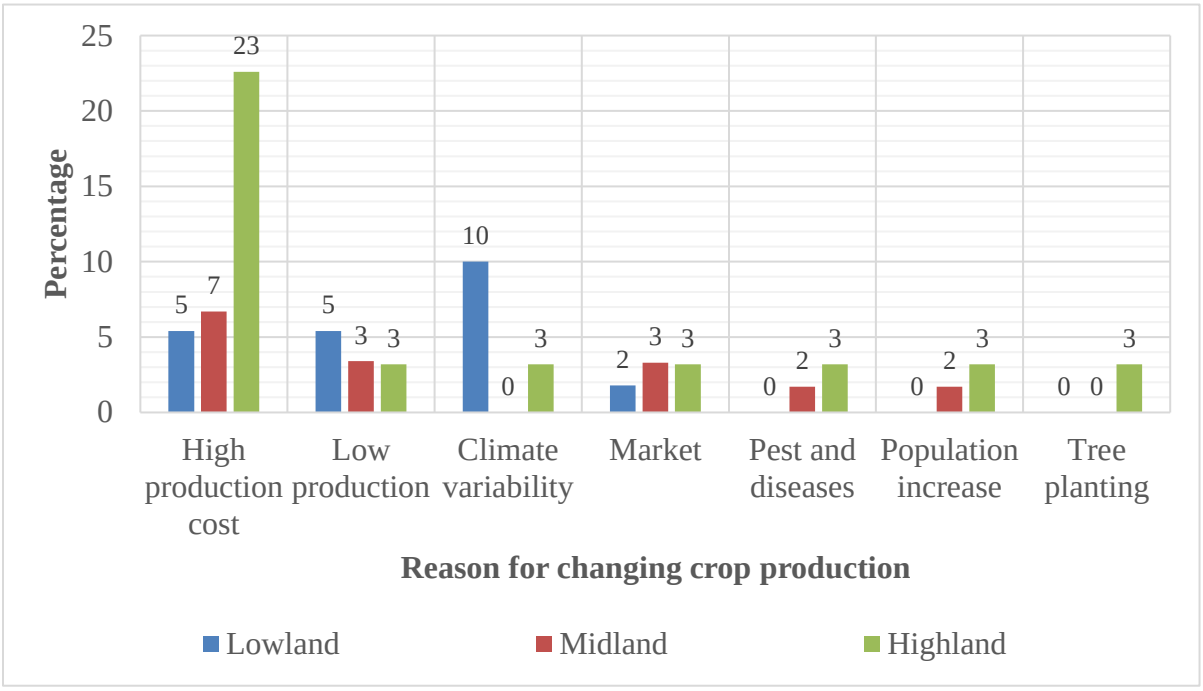

Figure 3 Factors agricultural crop production and reasons for changing the types of crop

The results in Figure 3 show that factors influencing the crop production included high production costs, unreliable markets and low productivity. Tree planting in the highland zone used as an alternative crop and provide opportunity for increasing household income. Whereas factors such as climate variability and/or drought, increase in pests and diseases; and population pressure denoted threat factors in crop production. The status of a given farm (size and fertility), access to inputs for the farmer, reliable markets, extension services and infrastructure, and policy issues were also important factors in crop production that were mentioned during FGDs and key informant interviews in all zones. Through the reasons for abandoning some crop varieties and adapting new crops, many respondents were able to identify a number of factors that affect agricultural crop production. Figure 4 shows the reason for adopting new crop in the study area.

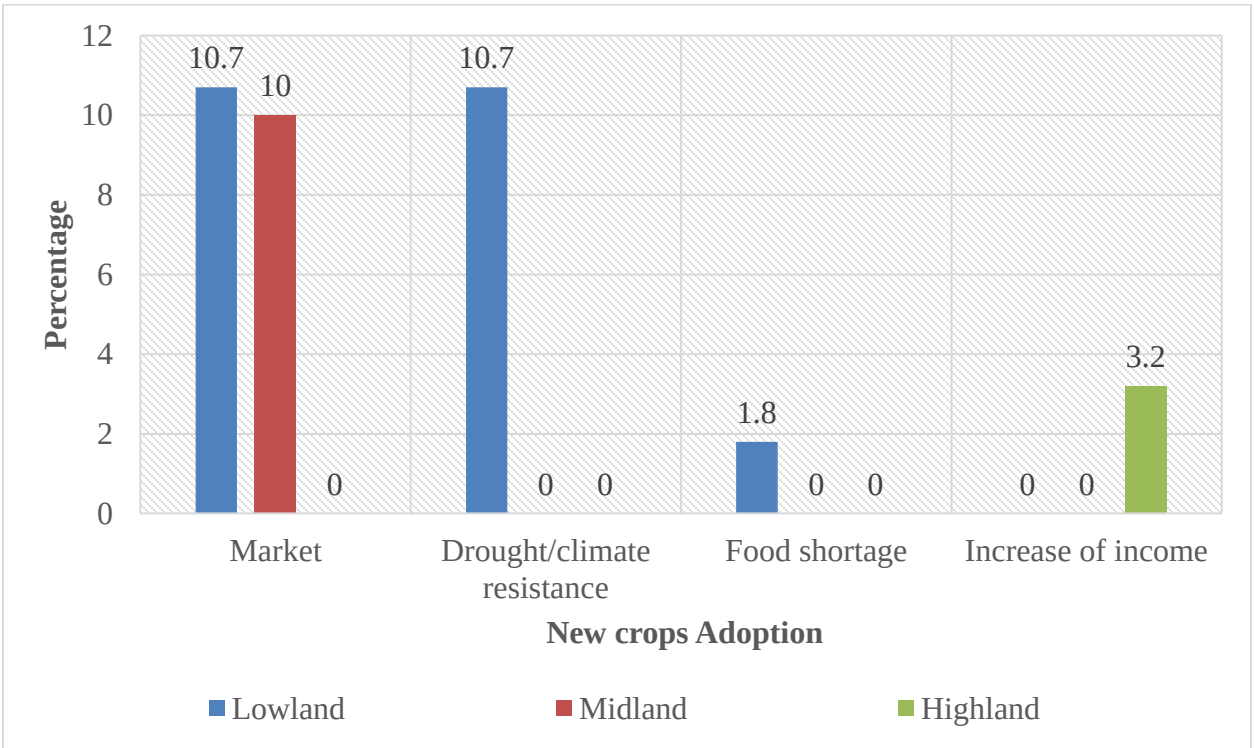

Figure 4 Reason for adopting new crops production

The results from Figure 4 indicates that in a lowland zone drought and market are the main factors for adopting new crop/ farming strategies followed by food security while in the midland and highland zones the market and increase of income are the main reason for adopting new crops/ farming strategies. Such results are in line with the study by Majule et al., (2007) and Lamboll et al., (2011) who revealed the differentiate factors for the farming systems in low potential areas and those in the high potential areas. The practices rely on different levels of land, water, labour, energy, capital and other inputs which, are significantly defined by local climatic and agro-ecological zones (Kristjanson et al., 2012). It also includes different uses of labour and other inputs, access to technologies, market information that characterized the players in agriculture (Wegner and Zwart, 2011; Darnhofer et al., 2012).

Data from this study show that there are other factors that were within, and those out of the control of the farmer. These exogenous factors affecting agricultural production can be classified into climate related, resource related, policy and institutional related factors. Factors such as population, market, institutional and organizational factors, location (e.g. Urban based), information and technology, and ecological conditions are examples in question.

4. CONCLUSIONS

The study revealed that farming systems practiced by smallholder farmers are characterized by land fragmentation, lack of capital, use of poor technologies, unreliable market and inadequate information to inform farmers the best adaptation measures and opportunities for increasing agricultural crop production. The risk and vulnerability found within small land sizes hinders crop diversification and mechanization to improve productivity. To a large extent of agricultural crop production in small units focused on home consumption and food security being the main concern. The choice, type of crops and production methods are influenced by a number of factors that determine a farming system. The Farming system in the all zones is determined partly by environmental factors of climate, soil, natural vegetation and topography and partly by socio-economic factors such as the customs of the people and level of technology, population density and financial resources. The study recommends the need for strengthening the capacity of farmers and institutions for identifying, assessing and addressing the challenges within different farming system through educating farmers and other relevant stakeholders on improving livelihoods, productivity and agricultural crop production.

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